

# Cranial Ultrasound in Newborn Live Demonstration

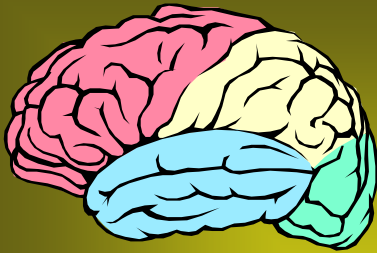
By

Abd Elazeez Shabaan

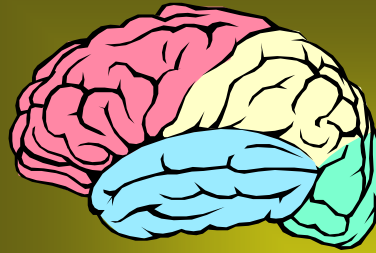
Lecturer of Pediatric and Neonatology,  
October 2011

# Outlines

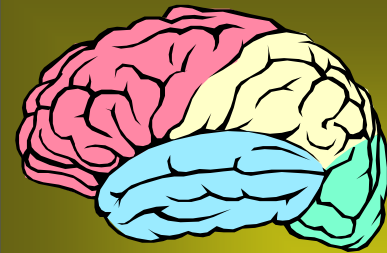
- Identify the different planes of section through the neonatal brain using ultrasound
- Describe the differences among anatomic structures included in each plane of section
- Describe the findings on cranial ultrasonography of intracranial hemorrhage, periventricular leukomalacia, and hydrocephalus.
- Locate pathology in the neonatal brain both in the sagittal and coronal planes



**Introduction**



**Normal scans**



**Abn scans**

- **Why cranial ultrasound is the first imaging mode of the newborn brain?**

- **It is safe, bedside- compatible and reliable**
- **It can be repeated as often as necessary, and thereby enables visualization of ongoing brain maturation and the evolution of brain lesions**

**American Institute of Ultrasound in Medicine (2006) . [www.aium.com](http://www.aium.com) •**

- It is a reliable tool for detection of most haemorrhagic, cystic, as well as calcifications, and major structural brain anomalies
- CUS is relatively inexpensive compared with other neuro-imaging techniques

- **What is the cranial US machine?**





## CUS Equipment and Procedure

- Modern, portable ultrasound machine
- Special CUS software
- Standard CUS settings; adjust when necessary
- Digital storage system
- Printed copies
- Avoid manipulation and cooling of infant
- Take necessary hygiene precautions

## Transducers

- 5–7.5–10 MHz
- Appropriately sized
- Standard examination: use 7.5–8 MHz
- Tiny infant and/or superficial structures: use additional higher frequency (10 MHz)
- Large infant, thick hair, and/or deep structures: use additional lower frequency (5 MHz)

- What is the optimum time for US screening?

NICU and/or <32 weeks GA  
and/or birth weight <1,500 g

High care and  $\geq 32$  weeks GA  
and  $\geq 1,500$  g

<24 h after birth

On the third day

Biweekly until the second week

Weekly until discharge

Around term<sup>a</sup>

More frequently in the case  
of (suspected) abnormalities

On the third day

Weekly until discharge

More frequently in the case  
of (suspected) abnormalities

- **What are the HUS guidelines at sunny brook hospital?**

- **All babies < 1500 grams or < 32 weeks:**
- **1<sup>st</sup> examination at 3rd day of life unless there is a reason to 1<sup>st</sup> exam earlier.**
- **The 2nd exam done at 7<sup>th</sup> day OL.**
- **The 3rd exam done at 21<sup>st</sup> day OL .**
- **The last exam done at 36<sup>th</sup> day OL .**
- **Abnormal exams should be repeated as indicated by the situation.**

- **What are the indications of cranial US in corrected FT newborn?**

- **Born prematurely, < 32 weeks**
- **Periventricular leukomalacia  $\geq$  stage 2**
- **Periventricular echodensities (flaring) still present at discharge/transfer**
- **History of meningitis or brain infections**

- **Periventricular haemorrhagic parenchymal infarction, brain abscesses, global hypoxic-ischaemic brain damage.**
- **P/IVH stage 3 and/or post-haemorrhagic ventricular dilatation, needing treatment.**

**Volpe (2001a).WB Saunders, Philadelphia**



- **What is the difference between standard US and supplemental US?**

## Standard CUS procedure

- Anterior fontanel = acoustic window (supratentorial structures)
- Scan whole brain from frontal to occipital and right to left
- Record at least six standard coronal and five standard (para)sagittal planes
- Record (suspected) abnormalities in two planes

## Supplemental acoustic windows

- Posterior fontanel (occipital parenchyma, occipital horns, posterior fossa)
- Mastoid fontanel (midbrain, posterior fossa, ventricular system)
- Temporal windows (midbrain, circle of Willis, flow measurements)

- **How images are assessed by cranial US?**

- **Anatomy**
- **Maturation**
- **Distinction of cortex/white matter**
- **Echogenicity of cortex**
- **Echogenicity/homogeneity of white matter**

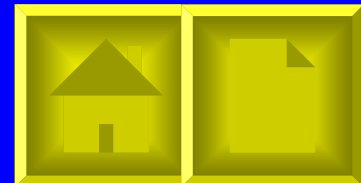
- **Echogenicity/homogeneity of deep grey matter**
- **Ventricular system: size, lining, echogenicity if dilated: perform serial measurements**
- **Width of subarachnoid spaces**
- **Midline shift**

- **When do you need others neuro imaging modalities?**

- **Term hypoxic-ischaemic encephalopathy**
- **Periventricular haemorrhagic parenchymal infarction (exact location and extent)**
- **Diffuse and/or non-cystic white matter damage**

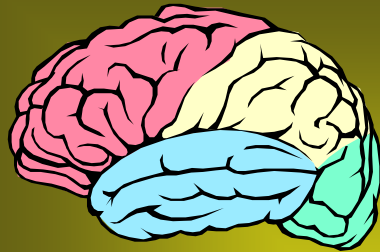


- **Extracerebral haemorrhage**
- **Sinus vein thrombosis**
- **Posterior fossa abnormalities (both congenital and acquired)**
- **Cortical dysplasia**
- **Infectious brain disease**
- **Metabolic disease**

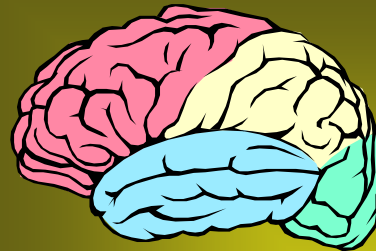




# Normal Scans



**Coronal**

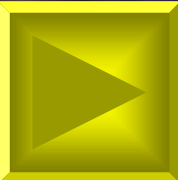
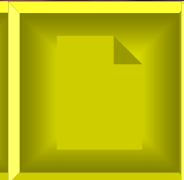
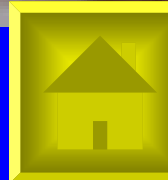


**Sagittal**

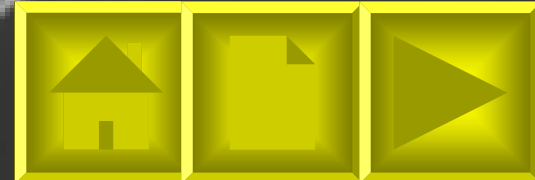
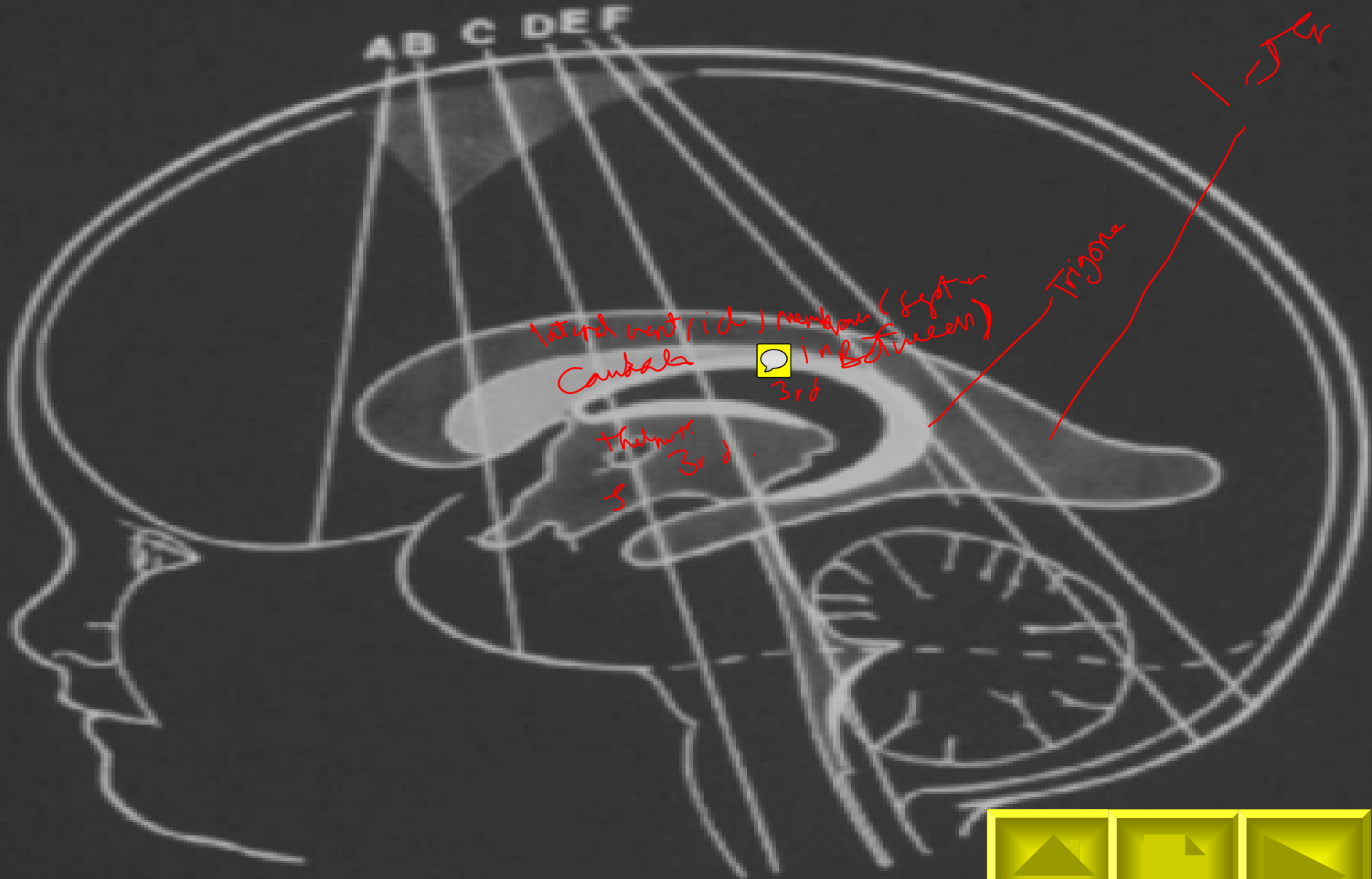




**Well-fitting ultrasound probe, positioned into the anterior fontanel. *Arrow* indicates the marker on the probe**



# Coronal Views



# Frontal Lobe



NATIONAL WOMENS

C8-5 Ped/Ceph

09 May 01

11:56:03

Tib 0.3 MI 0.8

F# 99 7.3 cm

Map 8  
DynRg 55dB  
Persist Med  
Fr Rate Med  
2D Opt:Res

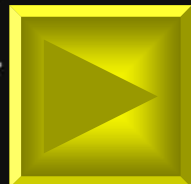
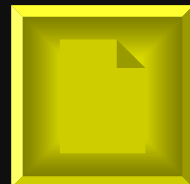
Interhemispheric fissure

Frontal lobes

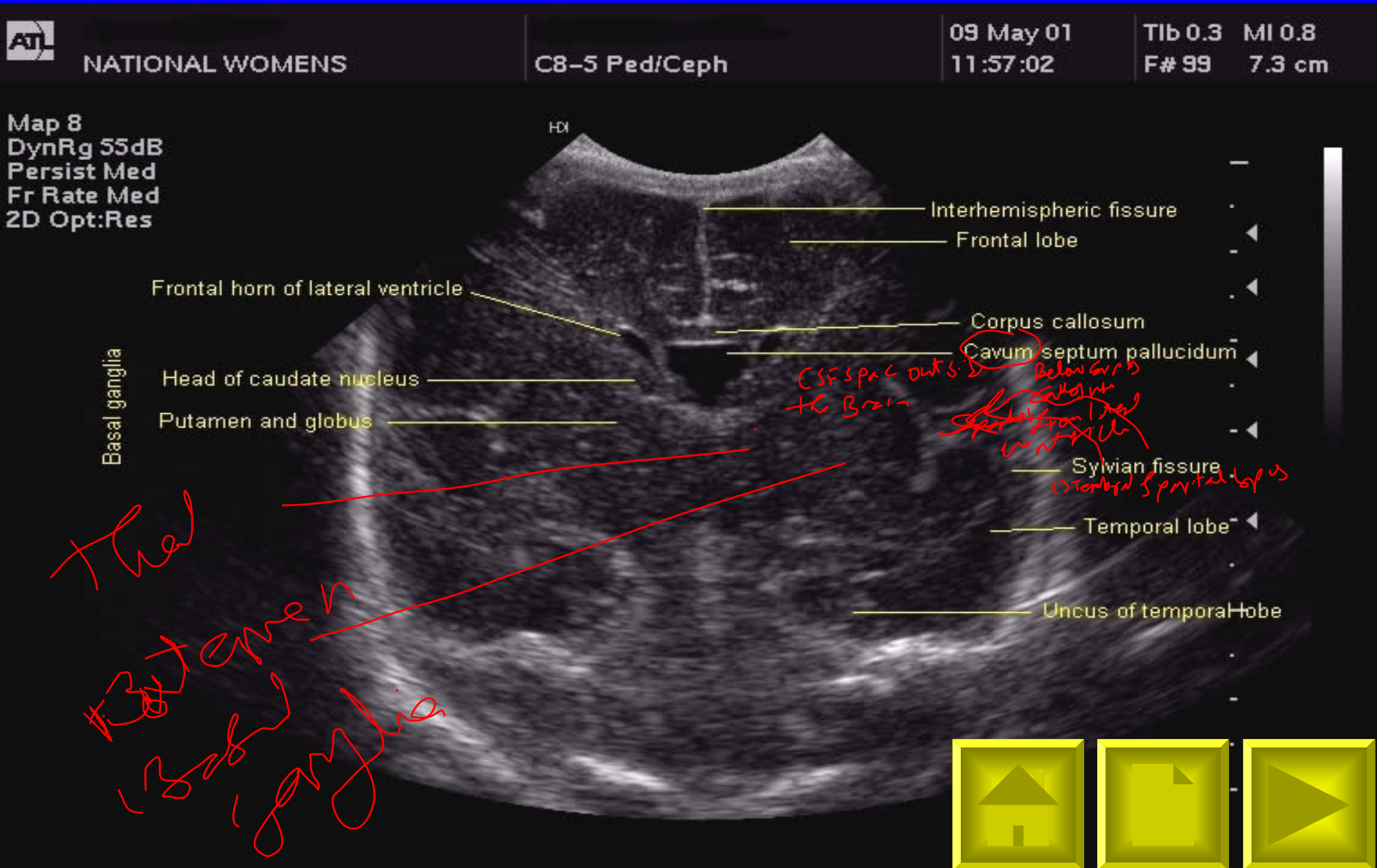
Orbital ridge

HDI

*GA Noe*



# Anterior horns of the lateral Ventricles



# The Third Ventricle

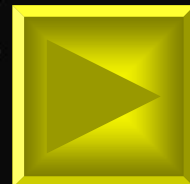
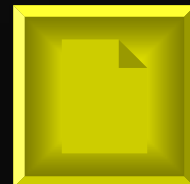
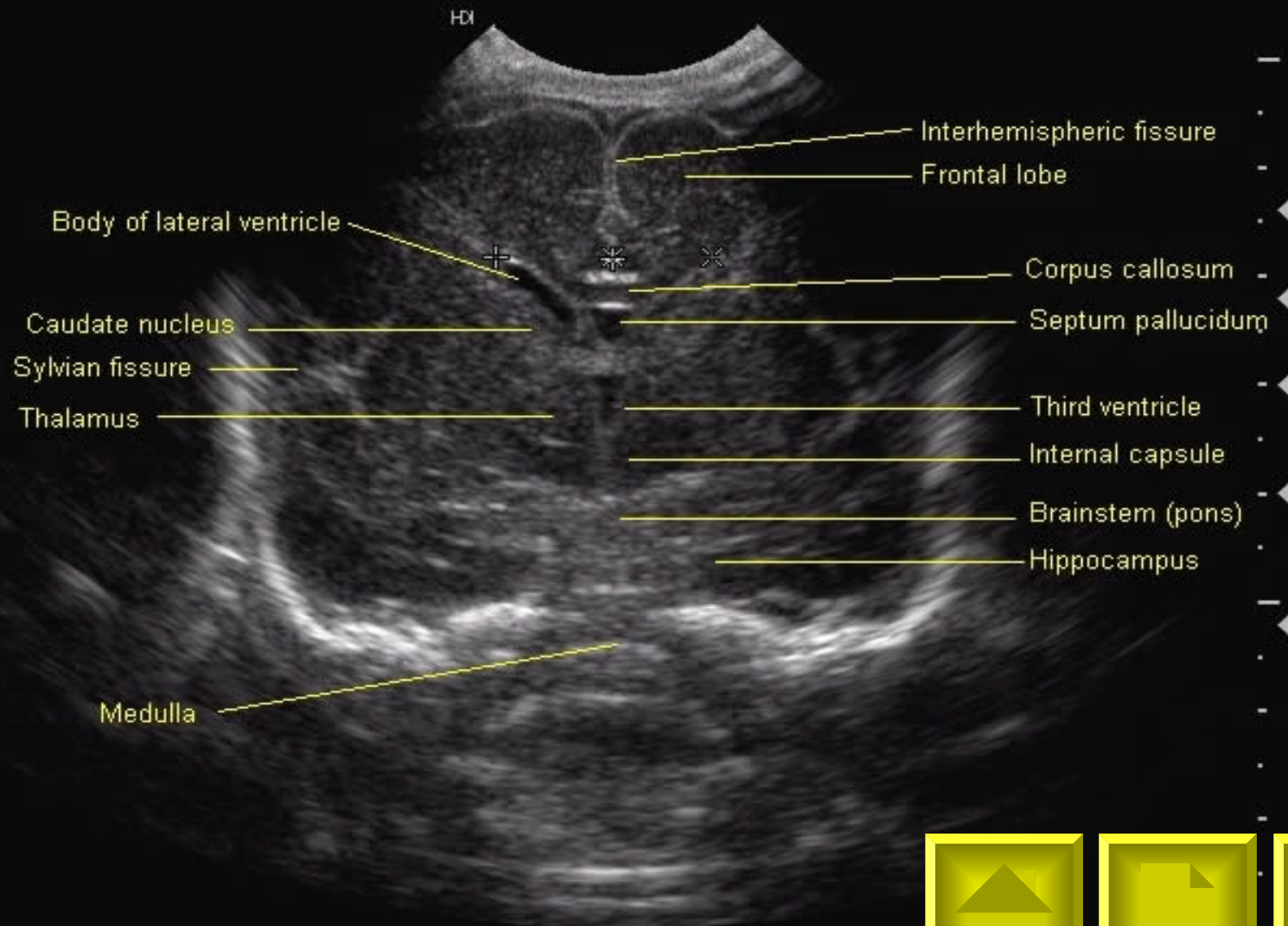


NATIONAL WOMENS HOSPITAL

C8-5 Ped/NWHD

9:04:04 am

Tib 0.2 MI 0.6  
F# 87 7.9 cm





# Trigone



NATIONAL WOMENS

C8-5 Ped/Ceph

09 May 01

11:57:27

Tib 0.3 MI 0.8

F# 96 7.3 cm

Map 8  
DynRg 55dB  
Persist Med  
Fr Rate Med  
2D Opt:Res

HDI

Interhemispheric fissure

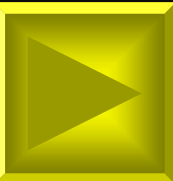
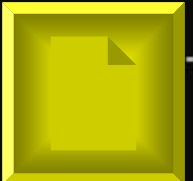
Parietal cortex

White matter forming periventricular "blush"

Trigone of lateral ventricle

*floor of lat vent  
midline part*

*inferior horn*





NATIONAL WOMENS

C8-5 Ped/Ceph

09 May 01

11:57:34

Tib 0.3 MI 0.8

F# 39 7.3 cm

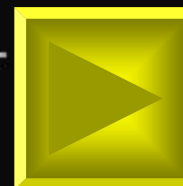
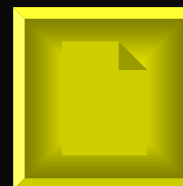
Map 8  
DynRg 55dB  
Persist Med  
Fr Rate Med  
2D Opt:Res

HDI

Parietal cortex

Interhemispheric fissure

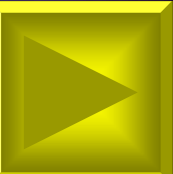
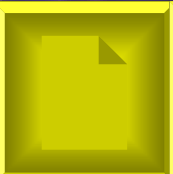
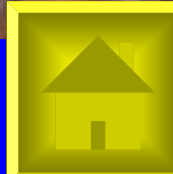
White matter forming periventricular "blush"



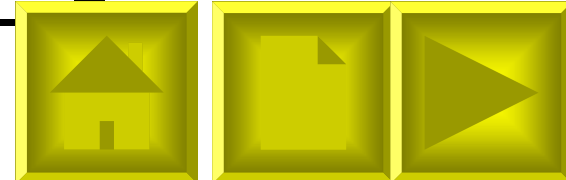
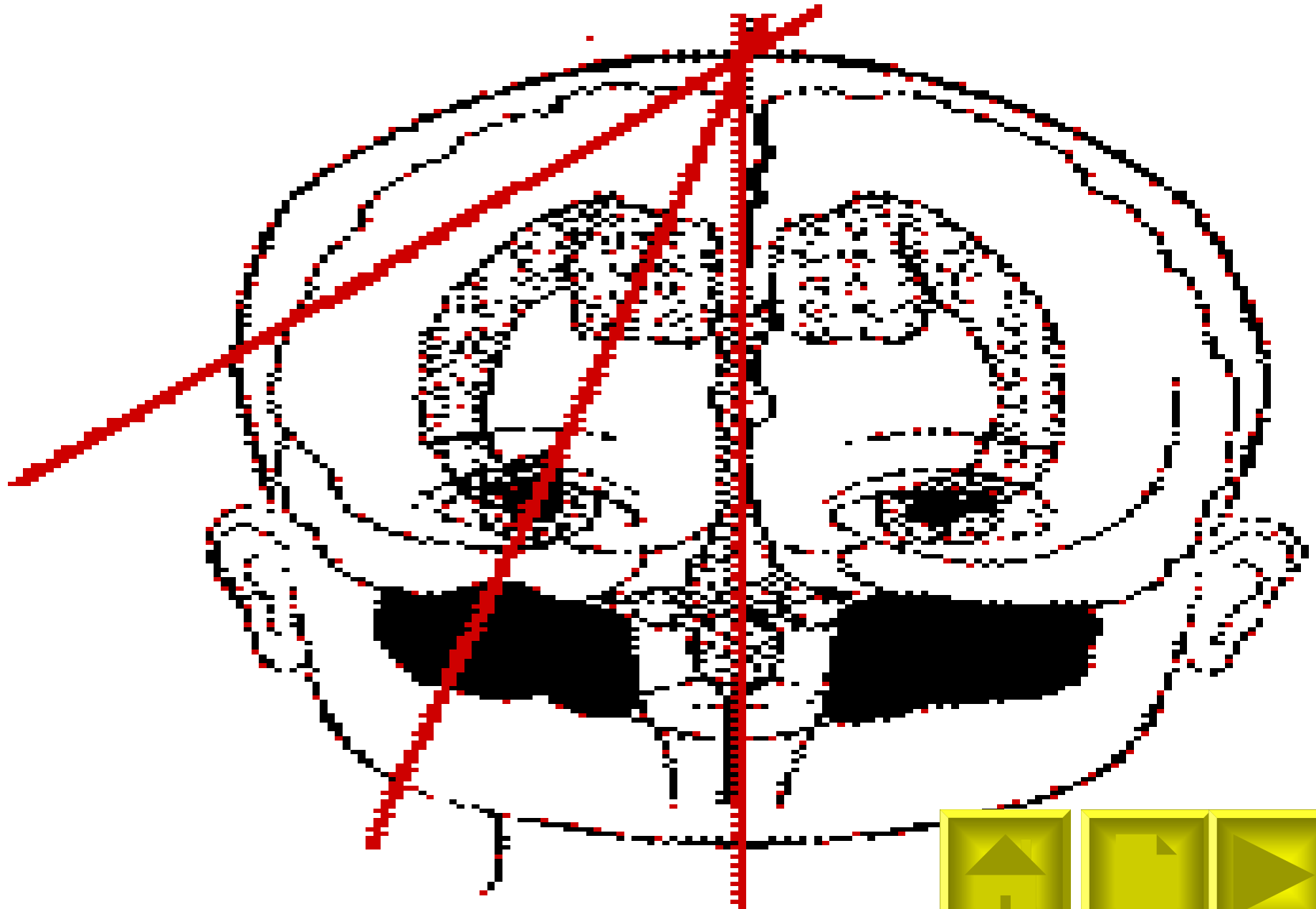




**Probe positioning for obtaining parasagittal scan. Arrow indicates marker**



# Sagittal Views



# Midline Sagittal



NATIONAL WOMENS

C8-5 Ped/Ceph

09 May 01

11:58:14

Tib 0.3 MI 0.8

F# 67 7.3 cm

Map 8  
DynRg 55dB  
Persist Med  
Fr Rate Med  
2D Opt:Res

HD

Cingulate gyrus

Corpus callosum

Occipital lobe

Tentorium cerebelli

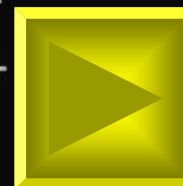
Quadrigeminal cistern

4th ventricle

Cerebellum

Pons

SAG M / L



# Angled Parasagittal



NATIONAL WOMENS

C8-5 Ped/Ceph

09 May 01

11:58:59

Tlb 0.3 MI 0.8

F# 99 7.3 cm

Map 8  
DynRg 55dB  
Persist Med  
Fr Rate Med  
2D Opt:Res

HDI

Frontal lobe

Caudo-thalamic groove

Caudate nucleus

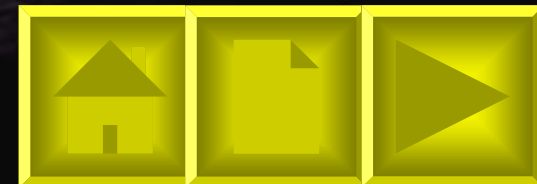
Thalamus

Lateral ventricle

Choroid plexus

Cerebellum

SAG RT



# Tangential Parasagittal



NATIONAL WOMENS

C8-5 Ped/Ceph

09 May 01

11:59:04

Tlb 0.3 MI 0.8

F# 27 7.3 cm

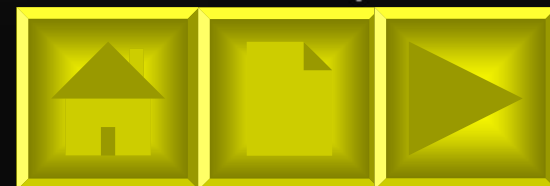
Map 8  
DynRg 55dB  
Persist Med  
Fr Rate Med  
2D Opt:Res

HDI

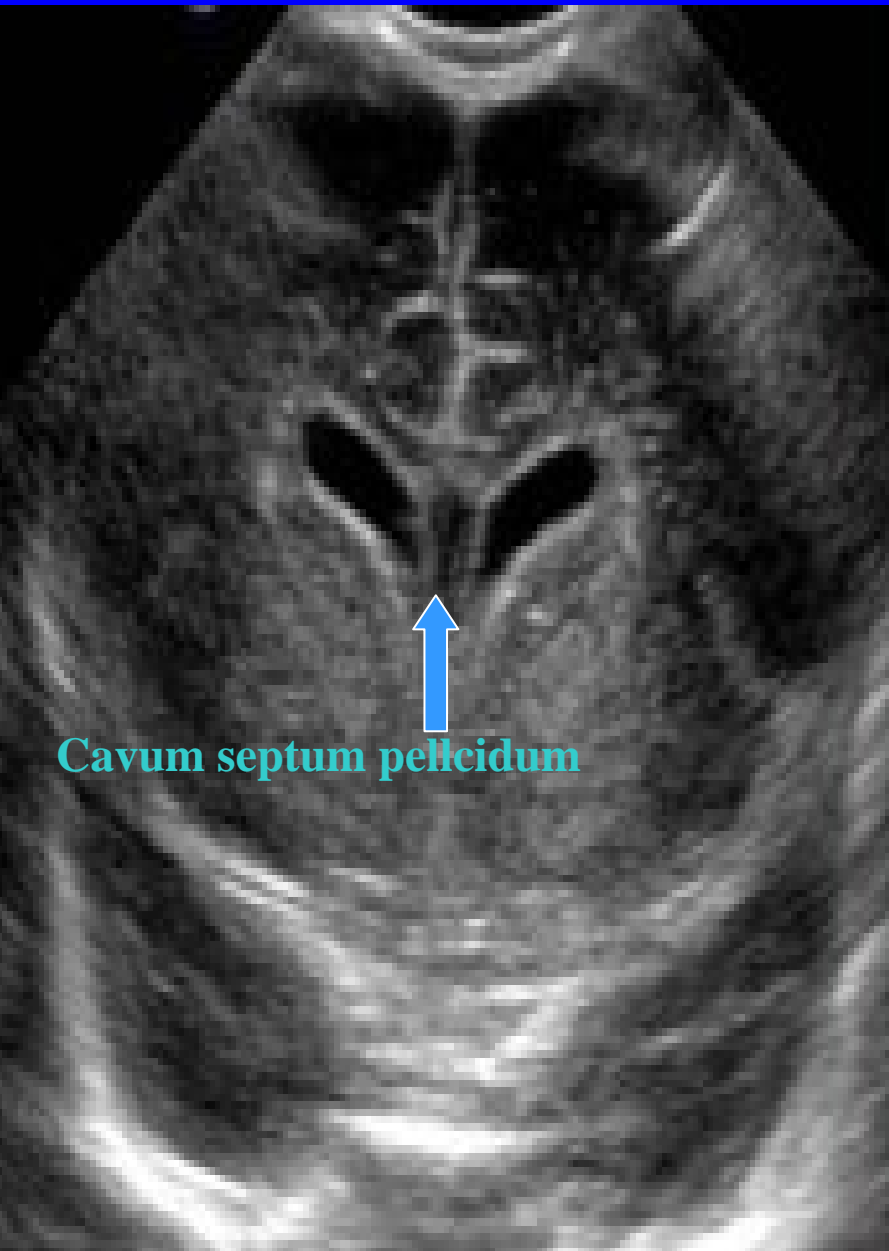
Sylvian fissure

Insula

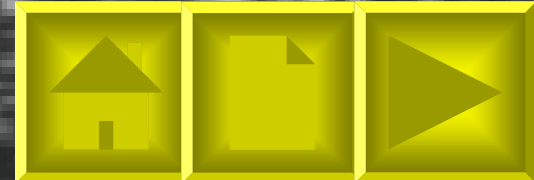
SAG RT

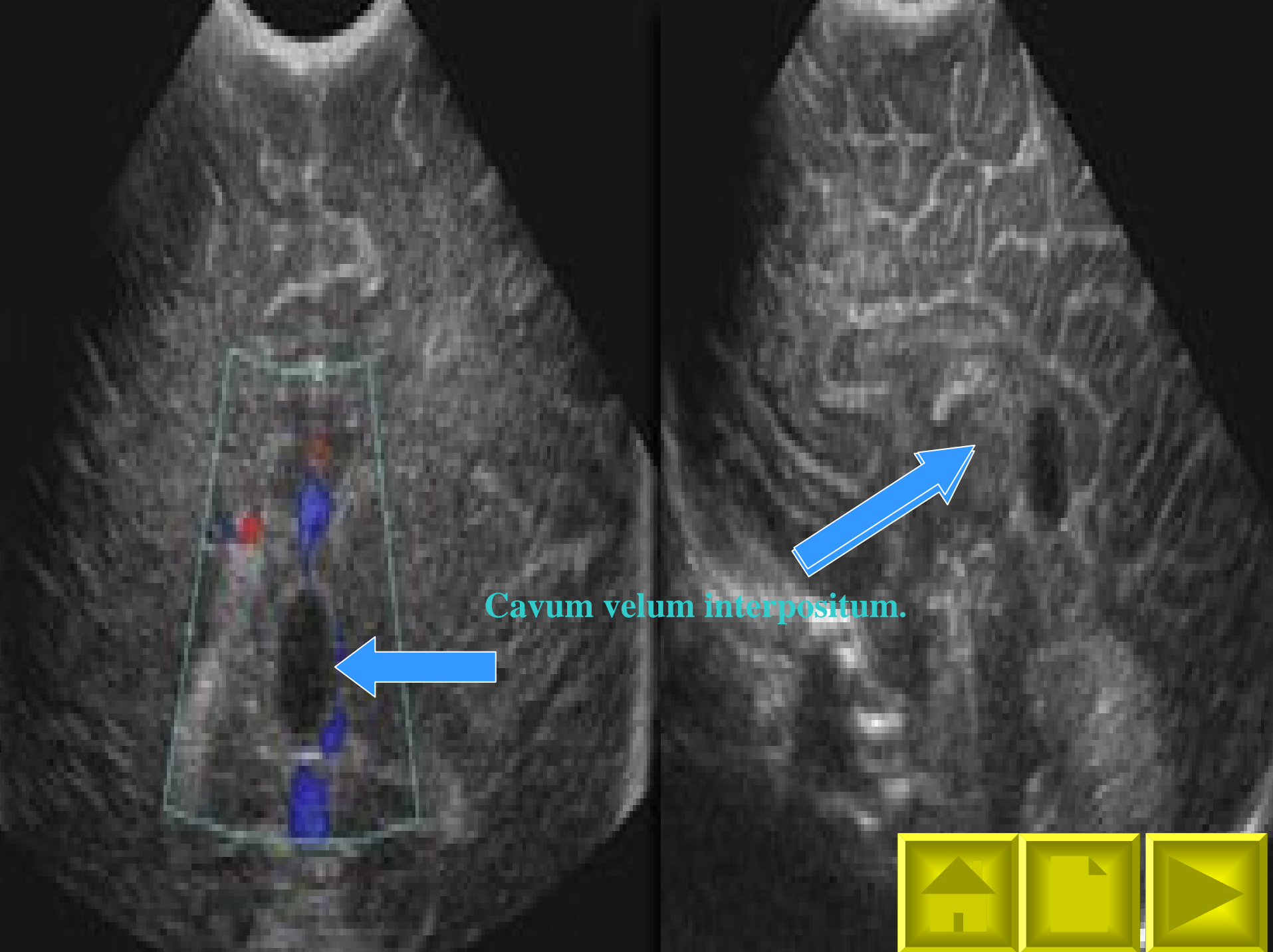


# Normal CUS varriant



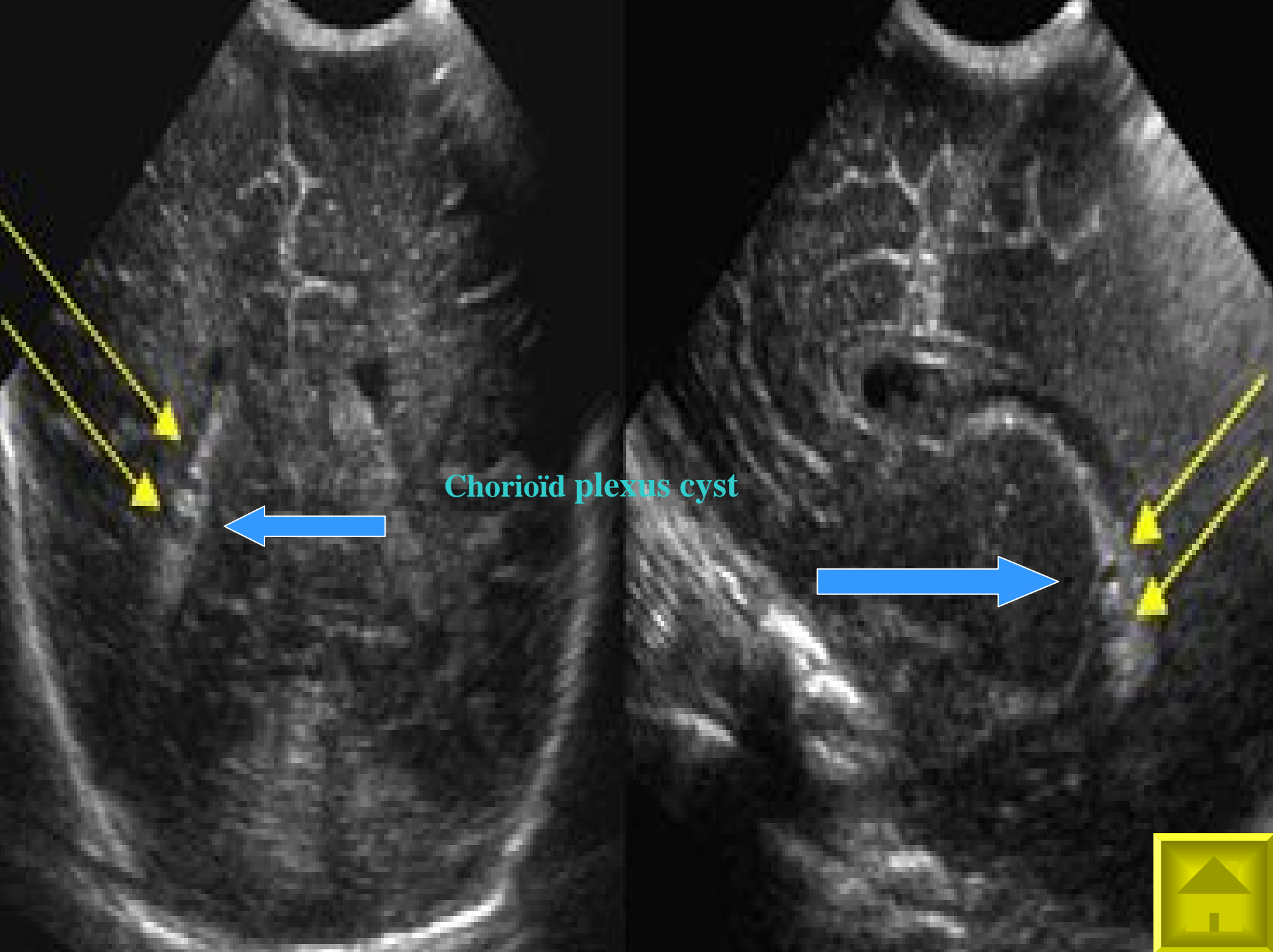
Cavum septum pellicidum





Cavum velum interpositum.



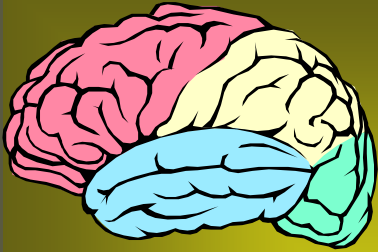


Chorioïd plexus cyst

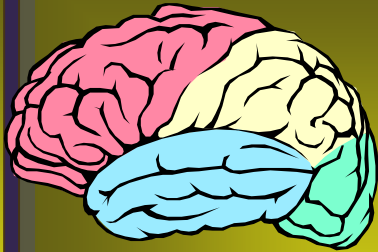




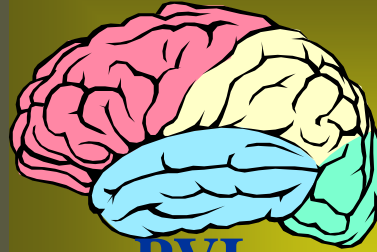
# Abnormal Scans



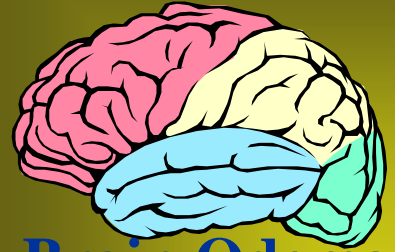
**IVH**



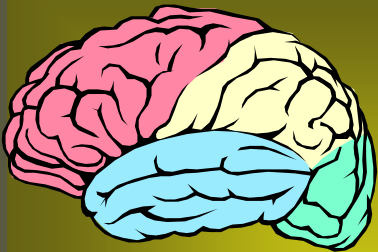
**PHVD**



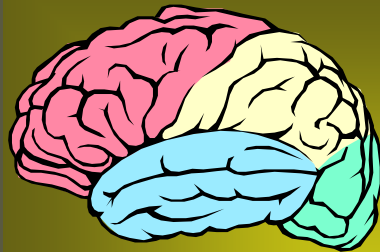
**PVL**



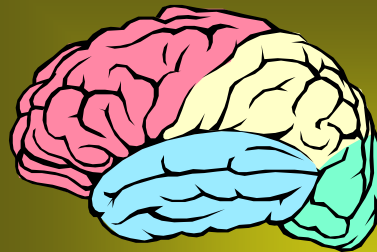
**Brain Odema**



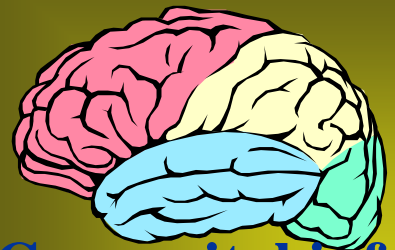
**FHC**



**ICT**



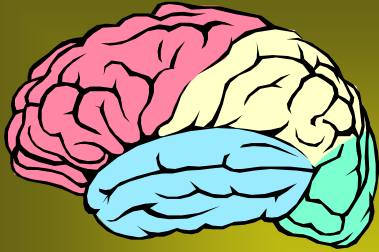
**DWV&VOG**



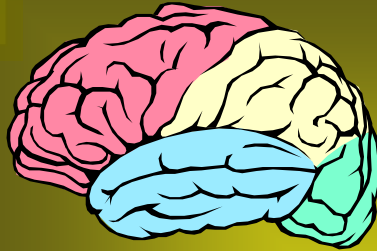
**Congenital infection**



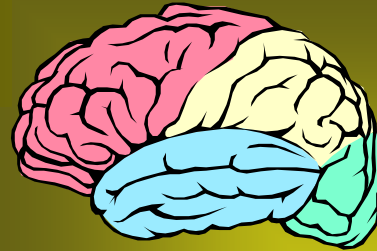
# Intracranial Haemorrhage



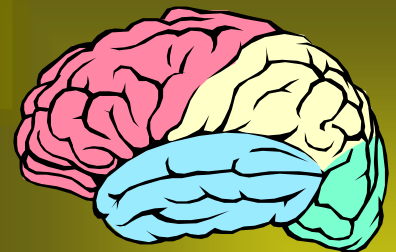
**Grade I**



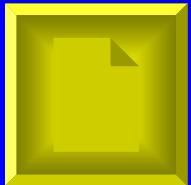
**Grade II**



**Grade III**



**Grade IV**



# Germinal matrix haemorrhage



NATIONAL WOMENS

C8-5 Ped/Ceph

10 Jul 01

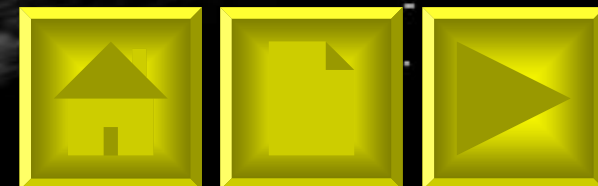
10:51:26

Tib 0.3 MI 0.8

F# 99 8.9 cm

Map 8  
DynRg 55dB  
Persist Med  
Fr Rate Med  
2D Opt:Res

  
**G1 IVH**





NATIONAL WOMENS

C8-5 Ped/Ceph

10 Jul 01

10:55:11

Tlb 0.3 MI 0.8

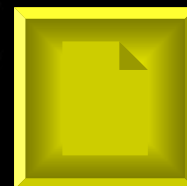
F# 24 8.9 cm

Map 8  
DynRg 55dB  
Persist Med  
Fr Rate Med  
2D Opt:Res

HDI

  
G1 IVH

SAG R





NATIONAL WOMENS NICU

C8-5 Ped/Ceph

12 Dec 02

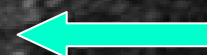
10:26:04

Tlb 0.3 MI 0.9

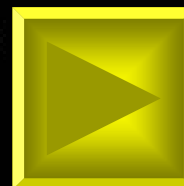
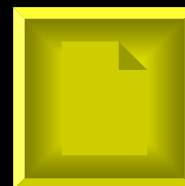
F# 99 7.9 cm

Map 8  
DynRg 55dB  
Persist Med  
Fr Rate Med  
2D Opt:Res

HDI



G2 GM IVH





NATIONAL WOMENS NICU

C8-5 Ped/Ceph

12 Dec 02

10:28:35

Tib 0.3 MI 0.9

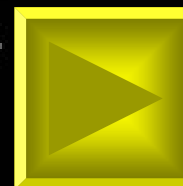
F# 99 7.9 cm

Map 8  
DynRg 55dB  
Persist Med  
Fr Rate Med  
2D Opt:Res

H01

  
G2 GM IVH

SAG LT





NATIONAL WOMENS HOSPITAL

C8-5 Ped/Ceph

04 Mar 01

9:16:02 am

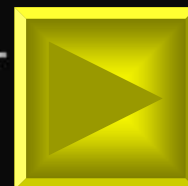
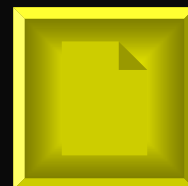
Tlb 0.4 MI 0.8

F# 60 7.3 cm

HDI



G3 GM IVH







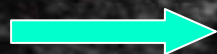
NATIONAL WOMENS HOSPITAL

C8-5 Ped/Ceph

03 Mar 01  
2:20:33 pm

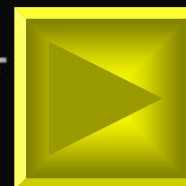
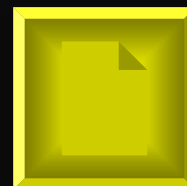
Tlb 0.3 MI 0.8  
F# 94 7.3 cm

HDI



G3 GM IVH

RIGHT







NATIONAL WOMENS

C8-5 Ped/Ceph

02 May 01

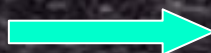
14:45:26

Tlb 0.3 MI 0.8

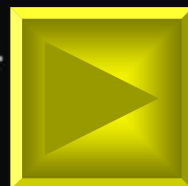
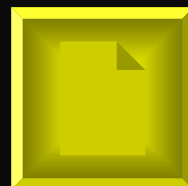
F# 98 7.3 cm

Map 8  
DynRg 55dB  
Persist Med  
Fr Rate Med  
2D Opt:Res

HDI



G4 GM IVH





NATIONAL WOMENS

C8-5 Ped/Ceph

02 May 01

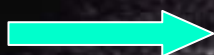
14:49:14

Tlb 0.3 MI 0.8

F# 25 7.3 cm

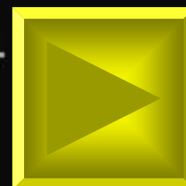
Map 8  
DynRg 55dB  
Persist Med  
Fr Rate Med  
2D Opt:Res

HDI



G4 GM IVH

SAG LT





NATIONAL WOMENS

C8-5 Ped/Ceph

17 May 01

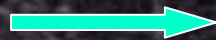
12:13:24

Tlb 0.3 MI 0.8

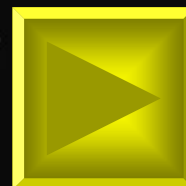
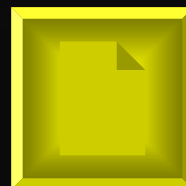
F# 98 7.9 cm

Map 8  
DynRg 55dB  
Persist Med  
Fr Rate Med  
2D Opt:Res

HDI



G4 GM IVH





NATIONAL WOMENS HOSPITAL

C8-5 Ped/Ceph

28 Aug 00

11:19:59 am

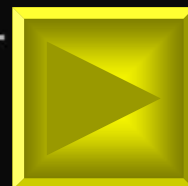
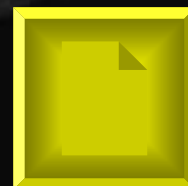
Tlb 0.4 MI 0.7

F# 34 11.9cm

HDI



Thalamic H





NATIONAL WOMENS HOSPITAL

C8-5 Ped/Ceph

28 Aug 00

11:22:21 am

Tlb 0.4 MI 0.7

F# 80 11.9cm

HDI

Thalamic H

SAG / ML





# Post Hemorrhagic hydrocephalus



NATIONAL WOMENS NICU

C8-5 Ped/Ceph

16 Jul 03

11:38:30

Tlb 0.4 MI 0.9

F# 96 9.9 cm

Map 8  
DynRg 55dB  
Persist Med  
Fr Rate Med  
2D Opt:Res

PHVD

0.55cm





NATIONAL WOMENS NICU

C8-5 Ped/Ceph

16 Jul 03

11:45:34

Tlb 0.5 MI 0.8

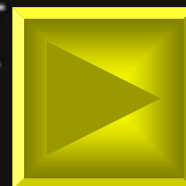
F# 93 9.9 cm

Map 8  
DynRg 55dB  
Persist Med  
Fr Rate Med  
2D Opt:Res

HCI

PHVD

SAG RTI



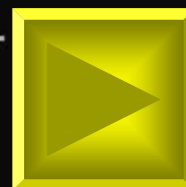
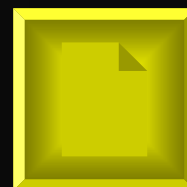
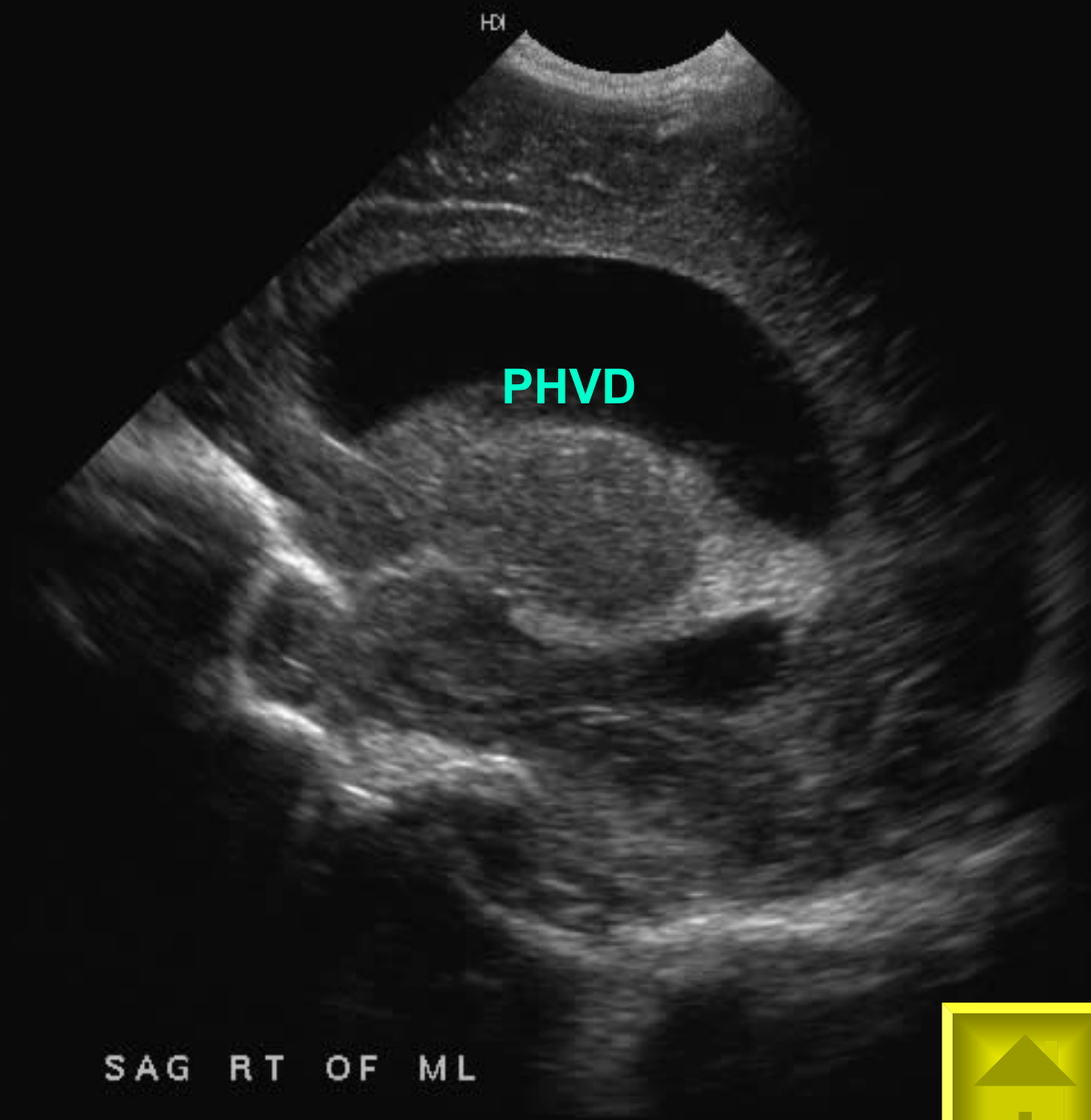


NATIONAL WOMENS HOSPITAL

C8-5 Ped/Ceph

21 Sep 00  
9:53:08 am

Tlb 0.4 MI 0.7  
F# 99 11.9cm







NATIONAL WOMENS NICU

C8-5 Ped/Ceph

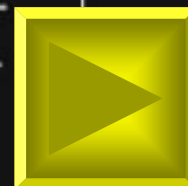
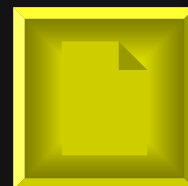
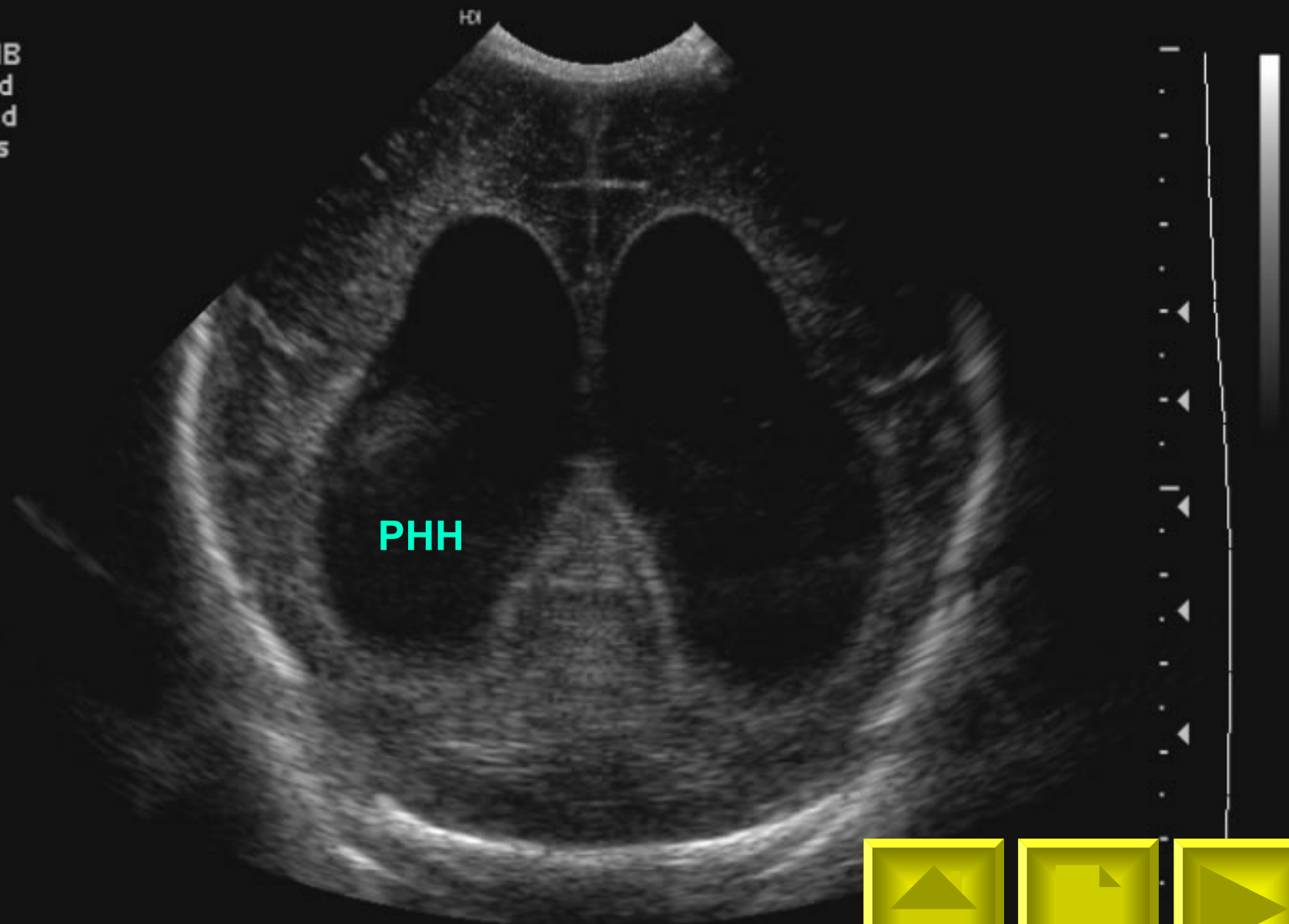
24 Jul 03

10:17:29

Tlb 0.5 MI 0.8

F# 99 9.9 cm

Map 8  
DynRg 55dB  
Persist Med  
Fr Rate Med  
2D Opt:Res





NATIONAL WOMENS NICU

C8-5 Ped/Ceph

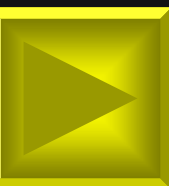
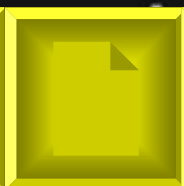
24 Jul 03

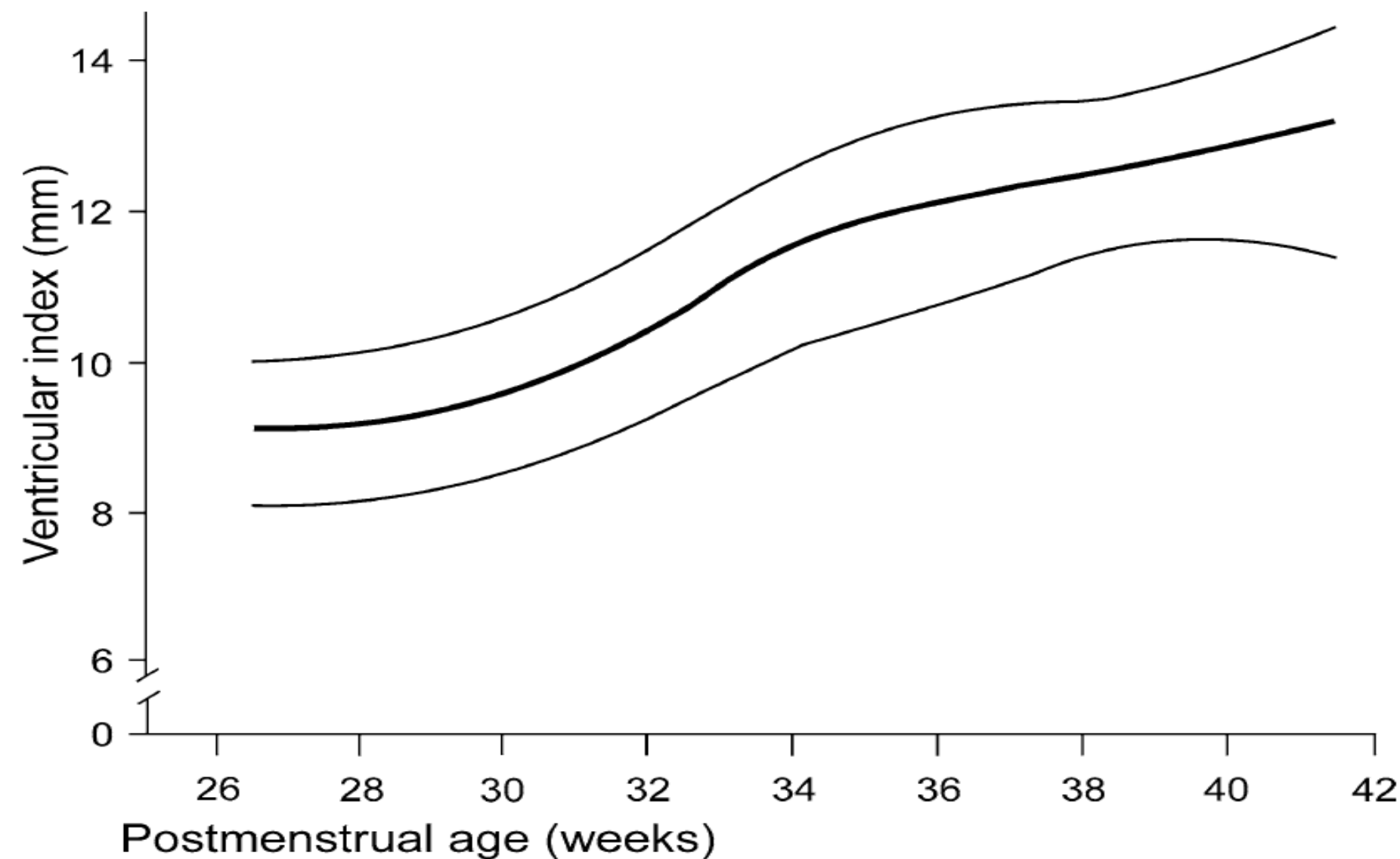
10:16:52

Tlb 0.4 MI 0.9

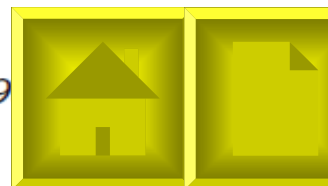
F# 86 9.9 cm

Map 8  
DynRg 55dB  
Persist Med  
Fr Rate Med  
2D Opt:Res

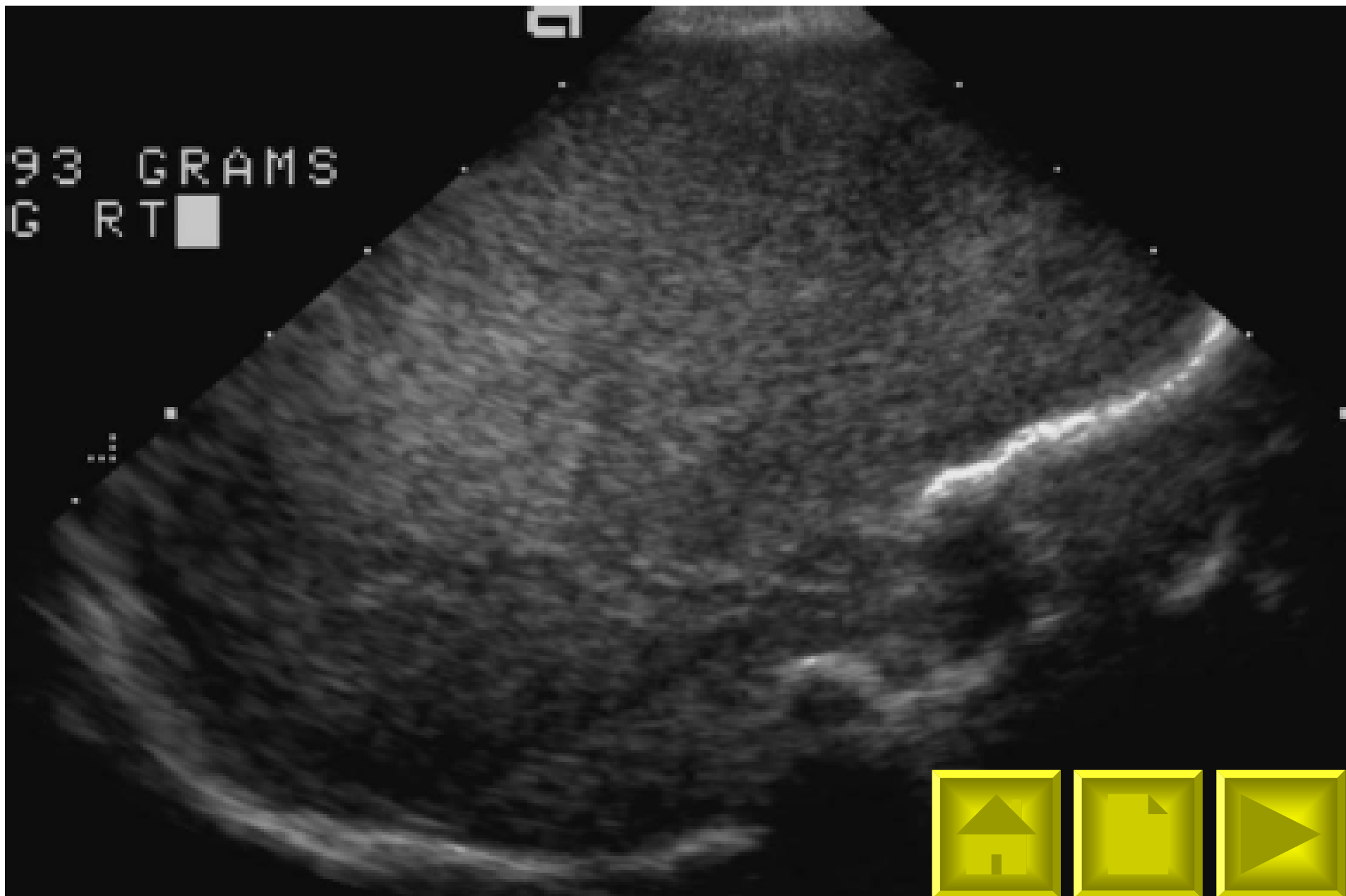




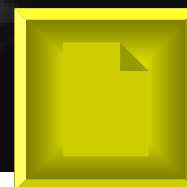
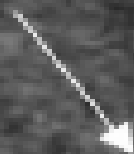
**Fig. 4.11** Growth charts of the ventricular index according to Levene (1991). Reproduced with permission from BMJ Publishing Group



# Brain Odema



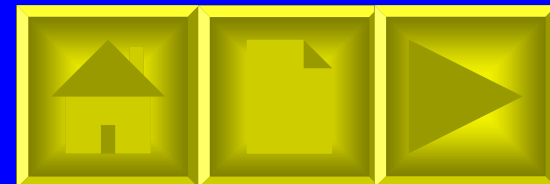
GRAMS



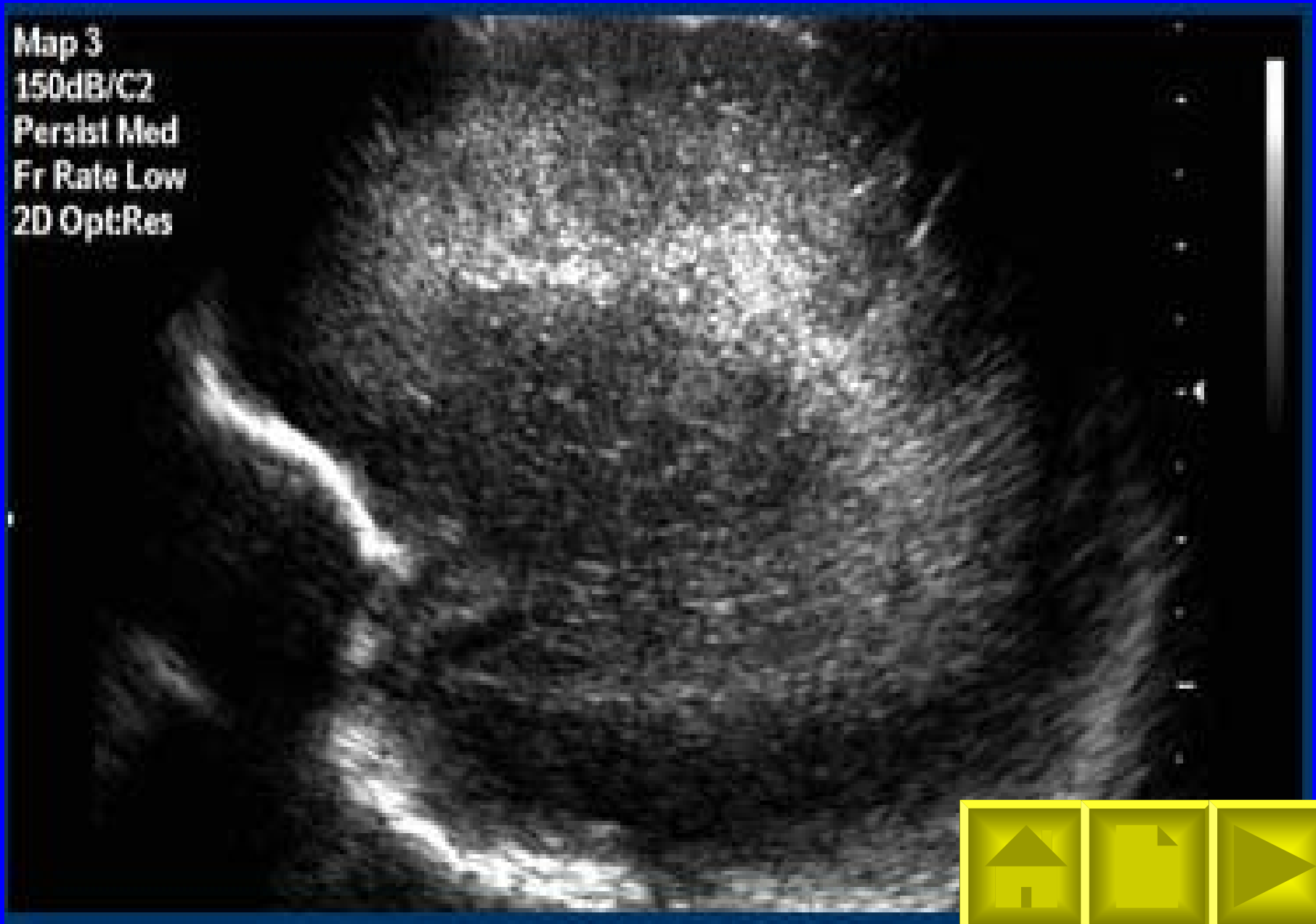
# Periventricular Leukomalacia G I

**PVL = Increased periventricular echogenicity**

- Grade 1.** Persisting more than 7 days
- Grade 2.** Developing into small periventricular cysts
- Grade 3.** Developing into extensive periventricular cysts, occipital and fronto-parietal
- Grade 4.** In deep white matter developing into extensive subcortical cysts



# PVL-grade 1



# Periventricular Leukomalacia G II



NATIONAL WOMENS

C8-5 Ped/Ceph

20 Jun 01

12:01:30

Tlb 0.3 MI 0.8

F# 90 8.9 cm

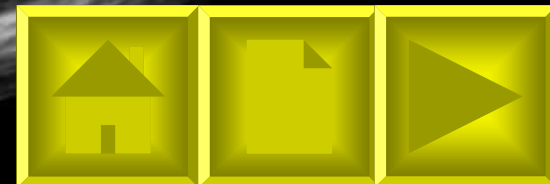
Map 8  
DynRg 55dB  
Persist Med  
Fr Rate Med  
2D Opt:Res

HDI



PVL II

SAG L







NATIONAL WOMENS

C8-5 Ped/Ceph

20 Jun 01

12:01:45

Tlb 0.3 MI 0.8

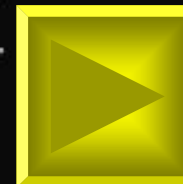
F# 82 8.9 cm

Map 8  
DynRg 55dB  
Persist Med  
Fr Rate Med  
2D Opt:Res

HDI

PVLII

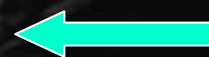
SAG L



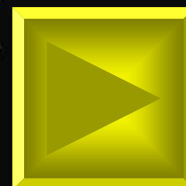
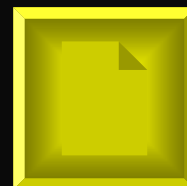


Map 8  
DynRg 55dB  
Persist Med  
Fr Rate Med  
2D Opt:Res

HDI



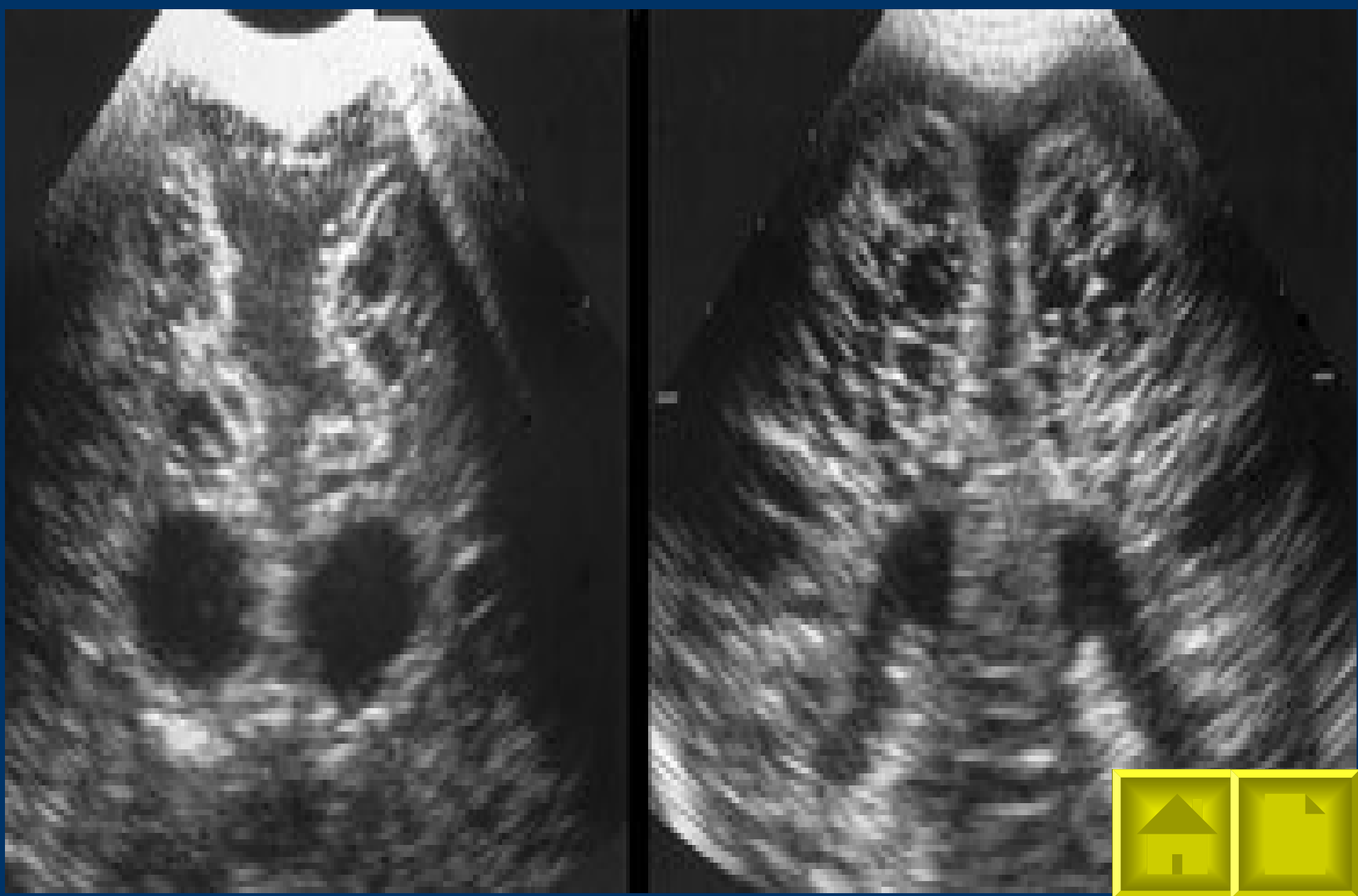
PVL II



# Periventricular Leukomalacia G III



# Periventricular Leukomalacia G IV



# Isolated Frontal Horn Cysts



NATIONAL WOMENS NICU

C8-5 Ped/Ceph

11:04:05

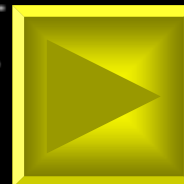
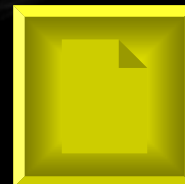
Tlb 0.4 MI 0.9  
F# 74 8.9 cm

Map 8  
DynRg 55dB  
Persist Med  
Fr Rate Med  
2D Opt:Res

HDI

→  
FHCS

SAG LT





NATIONAL WOMENS NICU

C8-5 Ped/Ceph

11:00:07

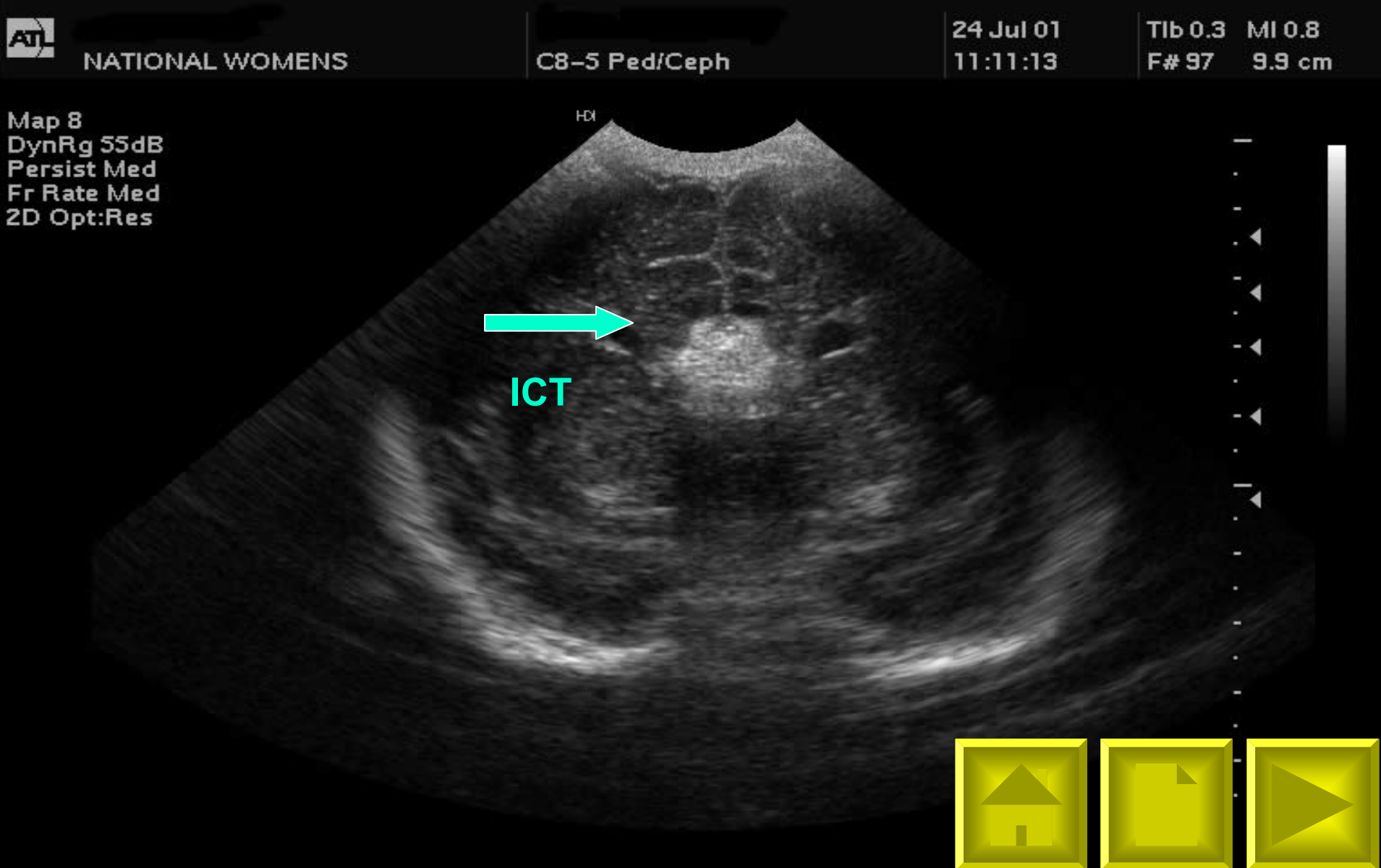
Tlb 0.6 MI 0.9  
F# 33 5.4 cm

Map 8  
DynRg 55dB  
Persist Med  
Fr Rate Med  
2D Opt:Res

←  
FHCS



# Intracranial Tumor and Aggenesis of the Corpus Callosum







NATIONAL WOMENS

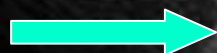
C8-5 Ped/Ceph

24 Jul 01  
11:17:49

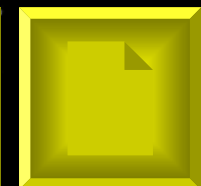
Tib 0.4 MI 0.9  
F# 67 9.9 cm

Map 8  
DynRg 55dB  
Persist Med  
Fr Rate Med  
2D Opt:Res

HDI



ICT





# Dandy-Walker Variant



NATIONAL WOMENS

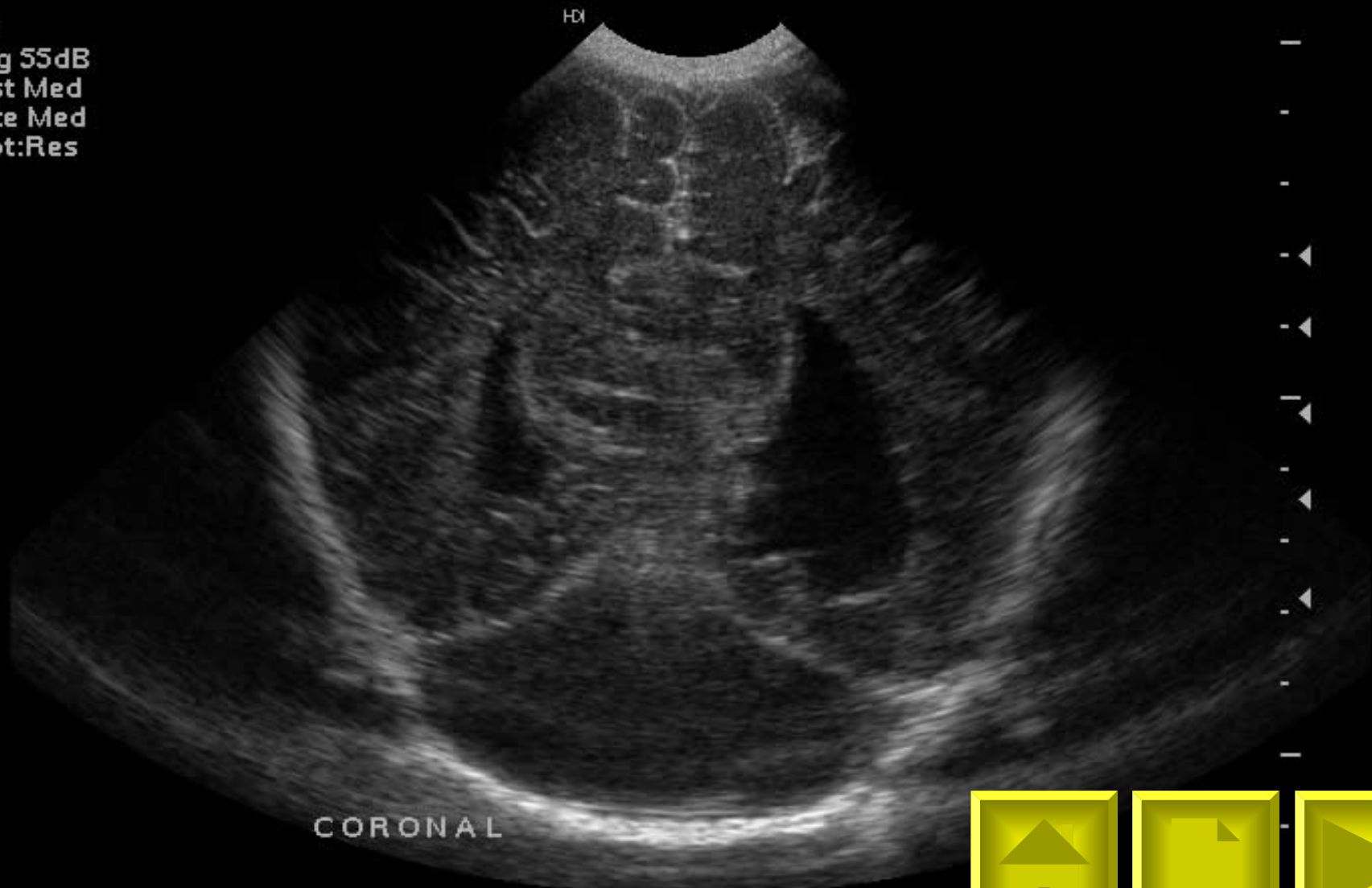
C8-5 Ped/Ceph

12:15:45

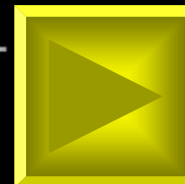
Tlb 0.4 MI 0.7  
F# 8 11.9cm

Map 8  
DynRg 55dB  
Persist Med  
Fr Rate Med  
2D Opt:Res

HDI



CORONAL





NATIONAL WOMENS

C8-5 Ped/Ceph

12:18:20

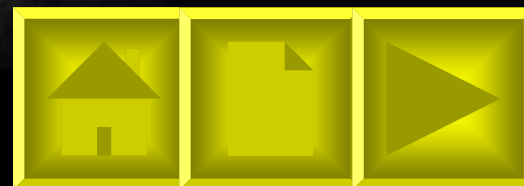
Tlb 0.3 MI 0.8  
F# 99 11.9cm

Map 8  
DynRg 55dP  
Persist Med  
Fr Rate Med  
2D Opt:Res

HDI

DWM

SAGITTAL LT



# Vein of Galen Malformation



NATIONAL WOMENS HOSPITAL

C8-5 Ped/NWHD

19 Feb 01

10:25:53 am

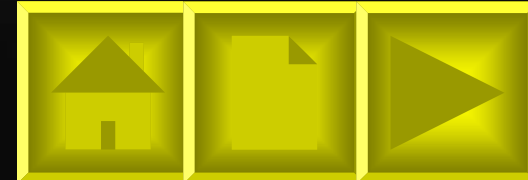
Tlb 0.2 MI 0.6

F# 99 9.9 cm

HDI



SAG RT





NATIONAL WOMENS HOSPITAL

C8-5 Ped/NWHD

19 Feb 01

10:29:00 am

Tlb 0.6 MI 0.5

F# 49 9.9 cm

HDI

+ 19.2

- 19.2  
cm/s

CORONAL



# Cytomegalovirus

HDI  
3500

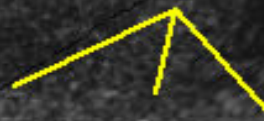
C8-5 Ped/Ceph

10:36:22

TIc 0.3 MI 0.9  
Fr #103 9.8 cm

Map 8  
130dB/C 5  
Persist Med  
Fr Rate Med  
2D Opt:Res

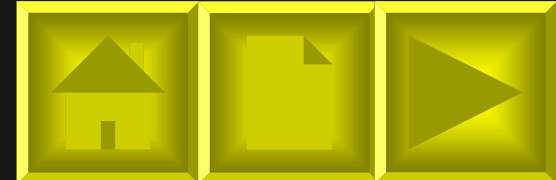
ATL



Calcifications

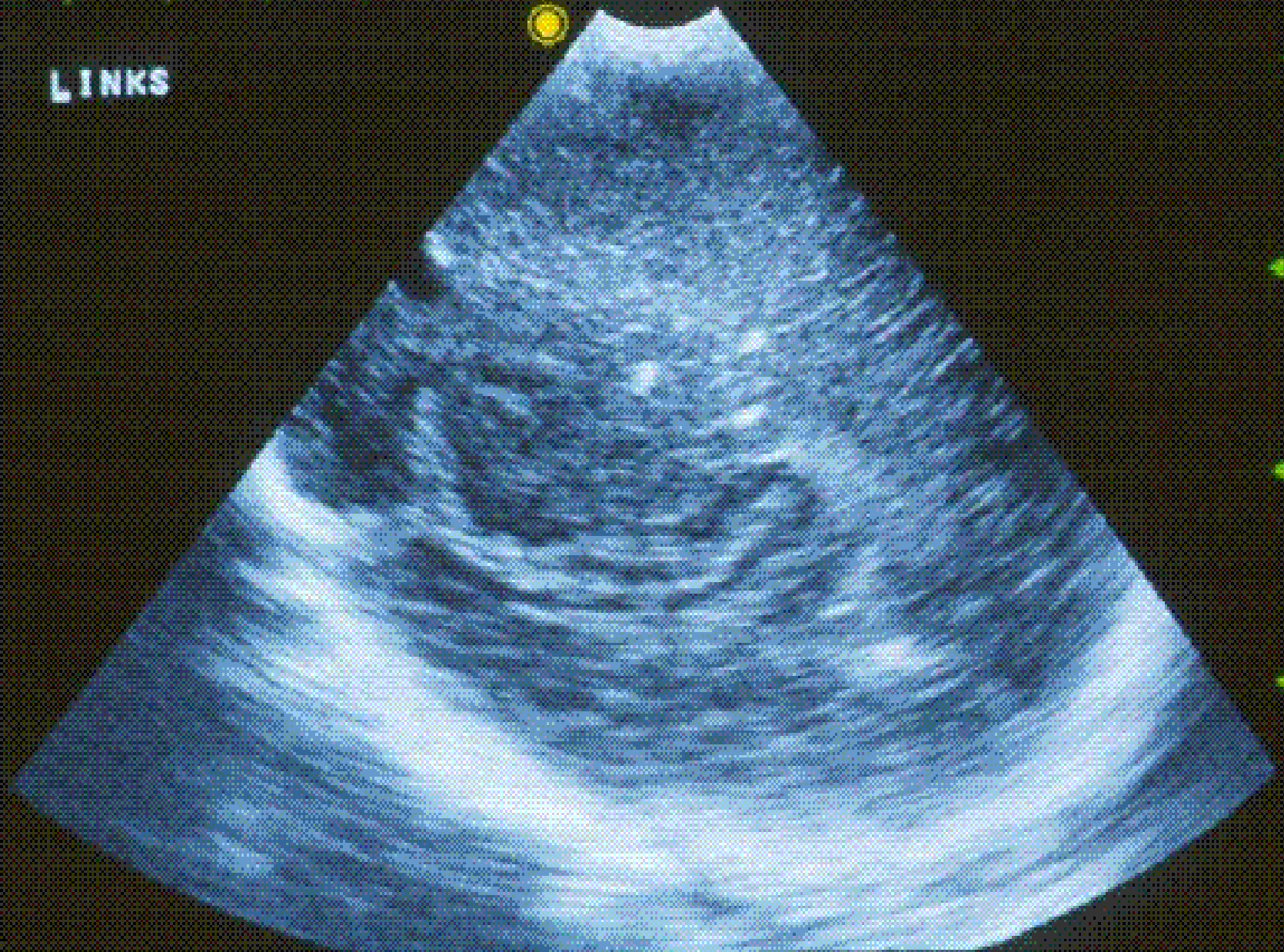


SAG LT





# Congenital Toxoplasmosis





The slandered frequency of the transducer of CUS IS:

- A. 3-5 MH
- B. 5-7MH
- C. 7-8 MH
- D. 9-10MH
- E. None of the above



The slandered CUS usually done through:

- A. Mastoid fontanel.
- B. Posterior fontanel
- C. Anterior fontanel
- D. Temporal window.
- E. All of the above

Indications of others neuroimaging modalities all of the following except:

- A. Extra cerebral hemorrhage**
- B. Sinus vein thrombosis**
- C. Post hemorrhagic ventricular dilatation**
- D. Infectious brain disease**
- E. Metabolic disease**

- **A very low-birthweight neonate has an unexplained drop in hematocrit within 72 hours after birth. Cranial ultrasonography reveals a germinal matrix hemorrhage. Of the following, the echogenicity associated with a germinal matrix hemorrhage is most likely to be located:**
  - A. In the caudothalamic groove.**
  - B. In the roof of the third ventricle.**
  - C. Posterior to the foramen of Monroe.**
  - D. Posteriorly in the lateral ventricle.**
  - E. Within the frontal horn.**

- **CUS, CT and MRI are modalities used in the diagnosis of intracranial pathology in newborns, of the following, the diagnosis most likely to be confirmed by CUS is:**
  - A. Brainstem abnormality.**
  - B. Central nervous system infection.**
  - C. Intracranial arteriovenous malformation.**
  - D. Hypoxic-ischemic encephalopathy.**
  - E. Subarachnoid hemorrhage.**

Thank you

